RHODORA, Vol. 91, No. 866, pp. 207–212, 1989

THE REDISCOVERY OF THE GLOBALLY ENDANGERED CLOVER, *TRIFOLIUM STOLONIFERUM,* IN INDIANA

MICHAEL A. HOMOYA, JAMES R. ALDRICH,
AND ELLEN M. JACQUART

ABSTRACT

Two populations of the globally endangered running buffalo clover (*Trifolium stoloniferum*) were recently discovered in Ohio County in southeastern Indiana. The habitats of the populations are limestone gravel wash, mesic upland forest, and mesic floodplain forest. All of the sites are grazed to various degrees by cattle. Absence of the clover in similar but ungrazed sites adjacent to the populations suggests that effects of grazing are beneficial. Suppression of competing understory vegetation is likely the most beneficial effect. The endangered status of *T. stoloniferum* probably reflects actual rarity, but misconceptions by botanists of the clover's morphology and habitat may account for the extreme paucity of recent collections. Recommendations for field survey techniques are given.

Key Words: *Trifolium stoloniferum,* endangered species, habitat, Indiana

INTRODUCTION

Since the publication by Brooks (1983) on the status of running buffalo clover (*Trifolium stoloniferum* Muhl. ex Eaton) and listing of the clover as a federally endangered species [Federal Register 52(108): 21478. June 5, 1987], a great deal of interest has been generated among botanists to locate populations of this rare native legume. The clover, a primarily midwestern species ranging from West Virginia to Kansas, has, for reasons unknown, seemingly disappeared. At the time of listing, only two extant populations were known, both in West Virginia (Bartgis, 1985). At this writing there are five known populations: two in West Virginia, two in Indiana, and one in Kentucky (Jacobs, 1987).

Indiana botanists were unaware until recently of any records of *Trifolium stoloniferum* for the state. The main reason for this ignorance is the absence of *T. stoloniferum* specimens in Indiana herbaria, and exclusion of the clover from the state's major floristic work, *Flora of Indiana* (Deam, 1940). We first learned of the clover's occurrence in Indiana from Brooks' (1983) paper, where three pre-1900 collections from Clark, Delaware, and Marion Counties were cited. The collections are housed in eastern U.S. herbaria, and as is true with most old collections, their labels lack suitable information for use in re-locating specific collecting

sites. What was useful to our re-location efforts however, was an 1816 diary entry by the early explorer and botanist David Thomas, who, while traveling through southeastern Indiana near the Ohio County community of Rising Sun, noted: "The buffalo, or wild clover, grows abundantly among the bushes, on the fertile though narrow flats of a small brook, down which the road winds. It appears to vegetate earlier than the white clover; or at least, the seed is sooner ripe" (Thomas, 1916). This description of the habitat (of what was apparently *T. stoloniferum*), along with the location information, proved to be significant to our search. On June 16, 1987, while surveying streambank terraces (narrow flats) in the hills near Rising Sun, possibly not far from Thomas' observation of the "wild clover," we located two populations of *T. stoloniferum.*

HABITAT

The two Indiana populations were discovered growing in and along two small tributaries approximately 2.5 km apart and within 3.0–5.5 km of the Ohio River. This area is similar to the adjacent Bluegrass region of Kentucky, so much so that Homoya et al. (1985) identified it as the Bluegrass Natural Region (of Indiana). The topography of this natural region, although glaciated, is surprisingly rugged, especially in the Switzerland Hills section where the clover occurs. Although cliffs are rare, bedrock composed of Ordovician limestone is evident, mainly as gravel and slabs in streambeds and on steep, eroding slopes. Most of the soil series present in the region are neutral to alkaline. The major native vegetation type is mesic deciduous forest, with American beech (*Fagus grandifolia* Ehrh.), sugar maple (*Acer saccharum* Marsh.), white ash (*Fraxinus americana* L.), chinquapin oak (*Quercus muhlenbergii* Engelm.), red oak (*Q. rubra* L.), blue ash (*Fraxinus quadrangulata* Michx.), American basswood (*Tilia americana* L.), Ohio buckeye (*Aesculus glabra* Willd.), and tulip tree (*Liriodendron tulipifera* L.) as typical dominants.

Running buffalo clover occurs in three specific habitat types: 1) narrow, mesic floodplain forest; 2) steep, mesic upland forest; 3) gravel wash located in small, high-gradient, ephemeral streams. The greatest number of individuals, occurring in five scattered colonies (one to thirty plants each), is situated on the lower slopes of the hills and on floodplain terraces that border the two pre-

viously mentioned tributaries. The sites are quite mesic, consisting of relatively rich, neutral, Eden flaggy silty clay loam (Nickell, 1981). Although the sites are forested, their understory is rather open due to the selective removal of vegetation by cattle grazing. Grazing intensity ranges from light to heavy, with the greatest number of *Trifolium stoloniferum* plants in the moderately grazed sites. Adjacent areas with similar environmental conditions, but without grazing (cattle are excluded by a fence), do not have the clover.

Although most of the lower canopy species have been reduced or removed by the grazing, the mid- and upper canopy species are still intact. These species include American sycamore (*Platanus occidentalis* L.), box elder (*Acer negundo* L.), red elm (*Ulmus rubra* Muhl.), Ohio buckeye (*Aesculus glabra* Willd.), pawpaw (*Asimina triloba* (L.) Dunal), and spicebush (*Lindera benzoin* (L.) Blume). Herbaceous associates of *Trifolium* include *Cryptotaenia canadensis* (L.) DC., *Carex jamesii* Schwein., *Pilea pumila* (L.) Gray, *Laportea canadensis* (L.) Weddell, *Leersia virginica* Willd., *Poa compressa* L., *Verbesina alternifolia* (L.) Britt., *Eupatorium rugosum* Houtt., *Alliaria petiolata* (Bieb.) Cavara and Grande, *Polemonium reptans* L., *Podophyllum peltatum* L., *Polygonum hydropiperoides* Michx., *P. punctatum* Ell., and *P. virginianum* L.

The gravel wash sites, where three *Trifolium stoloniferum* colonies occur, consist of slightly elevated, rocky bars and narrow braids of Ordovician limestone gravel and slabs. Although plants in the gravel wash are sometimes damaged by occasional high stream flow, the scouring action prevents establishment of woody species and consequently exposes the clover to light intensities higher than are normally found in undisturbed mesic forest environments. These higher light intensities may be an important factor in perpetuating the clover in areas that otherwise are too shaded to supply the critical light needs of the clover (see later discussion). Species associates of the clover in the gravel wash include *Pilea pumila, Leersia virginica, Eupatorium rugosum, Polygonum hydropiperoides, Lysimachia nummularia* L., *Trifolium repens* L., *T. hybridum* L., *Taraxacum officinale* Weber, *Acalypha rhomboidea* Raf., and *Festuca elatior* L.

COMMENTS ON REASON FOR RARITY

One reason for the decline of *Trifolium stoloniferum,* as suggested by Bartgis (1985), has been the elimination from the clo-

ver's range of bison and their attendant disturbances. The implication is that the clover's requirements are uniquely tied to bison, and as bison disappeared, so did the clover. Although we do not question the former importance of bison in the clover's ecology, we suggest that it is not any inherent quality of bison that is critical, but rather, the removal or suppression of competing vegetation, regardless of the agent responsible. Supporting this contention is the fact that all known extant populations of the clover occur either along trail openings or in sites grazed by livestock or infrequently mowed (Bartgis, 1985; Jacobs, 1987). We suspect that without removal or suppression of competing vegetation, a site becomes too shaded, especially in mesic forest communities, to satisfy minimum light needs of the clover. Therefore, communities that are not maintained to suppress competing vegetation are generally unsuitable for *T. stoloniferum.* This observation thus explains the clover's absence in ungrazed sites immediately adjacent to existing populations in Indiana.

Grazing by exotic livestock, at least to a certain degree, can evidently establish and maintain *Trifolium stoloniferum* habitat. Given this, how can it be that the clover has declined, as there appears to be no time in our history when grazing, either by bison or livestock, has not been common? At this time the question cannot be adequately answered. Several other suggested causes for the decline, including severe landscape alteration, disease, loss of rhizobial associates, fire suppression, competition from exotics, and predation, may all prove to be important (Brooks, 1983; Bartgis, 1985; Davis, 1987; Jacobs and Bartgis, 1987), but more research is obviously needed.

One overlooked factor that may account for the paucity of currently known populations of *Trifolium stoloniferum* is an apparent misconception of the species' habitat. As Brooks (1983) pointed out, and our experience confirms, the clover grows predominantly in moist, well-drained woodland associated with watercourses. It generally does not, as Fernald (1950) and Gleason (1952) stated, occur in dry woodlands and prairies. This confusion may stem from the assumption by botanists (including Fernald and Gleason) that the habitat of *T. stoloniferum* is the same or similar to that of the other buffalo clover, *Trifolium reflexum* L., a plant typically occurring in dry, open sites (that are commonly acid in reaction as well). Not surprisingly then, we have encountered several botanists who have searched for *T. stoloniferum* in

the wrong habitat. Similarly, many botanists avoid forest sites that are grazed, further reducing the possibility of finding the clover.

Another hindrance to field recognition by botanists is the illustration of *Trifolium stoloniferum* in Gleason (1952), which showed two widely spaced leaves on the flowering stem, and gave the impression that the stem is leafy throughout. In fact, the stem is essentially scapose except for two opposite or subopposite leaves that subtend the inflorescence. This distinction was also omitted from the text. Although one can correctly key to *T. stoloniferum* in Gleason, the illustration can give one an incorrect search image for detecting plants in the field.

RECOMMENDATIONS FOR FIELD SURVEYS

In all likelihood *Trifolium stoloniferum* is indeed a rare species. However, it is probable that the clover exists in several as yet undiscovered sites. Summarizing the information for the purpose of further surveys, the clover should be sought in disturbed mesic forests, particularly those along watercourses that have limestone and/or neutral to alkaline soils. Presence of limestone and/or alkaline soils may reflect a critical habitat requirement for the clover because the majority of the collections throughout its range, excepting those in West Virginia, were made in regions having predominantly alkaline substrates. Ideally, the sites should have an open understory, subject to light to moderate grazing or infrequent mowing. Limestone gravel wash sites, especially those within high-gradient streams, should also be inspected. One should search for a stoloniferous clover that has the appearance of a large, robust *Trifolium repens*. Unlike *T. repens, T. stoloniferum* does not produce a scape at anthesis, but rather an inflorescence subtended by a pair of leaves. In the absence of flowering stems, *T. stoloniferum* can be distinguished from *T. repens* by its green, leafy stipules (1–2 cm long) at the petiole attachment to the stolon. *Trifolium repens* has pale stipules generally less than 1 cm in length.

ACKNOWLEDGMENTS

The authors thank Terrie Temple, Mary Wadel, Barbara Homoya, and the Indiana Department of Natural Resources for their

assistance and support. We also thank the U.S. Fish and Wildlife Service for funding the field surveys to locate *Trifolium stoloniferum* in Indiana.

LITERATURE CITED

BARTGIS, R. L. 1985. Rediscovery of *Trifolium stoloniferum* Muhl. ex A. Eaton. Rhodora 87: 425–429.

BROOKS, R. E. 1983. *Trifolium stoloniferum,* running buffalo clover: description, distribution, and current status. Rhodora 85: 343–354.

DAVIS, W. H. 1987. On the decline of *Trifolium stoloniferum.* Kentucky Native Plant Society Newsletter 2(3): 10.

DEAM, C. C. 1940. Flora of Indiana. Department of Conservation, Indianapolis, IN.

FERNALD, M. L. 1950. Gray's Manual of Botany, 8th ed. American Book Company, New York.

GLEASON, H. A. 1952. The New Britton and Brown Illustrated Flora of the Northeastern United States and Adjacent Canada. New York Botanical Garden, New York.

HOMOYA, M. A., D. B. ABRELL, J. R. ALDRICH AND T. W. POST. 1985. The natural regions of Indiana. Proc. Indiana Acad. Sci. 94: 245–268.

JACOBS, J. 1987. Running buffalo clover discovered at new sites. United States Fish and Wildlife Service Endangered Species Technical Bulletin 12(9): 4.

——— AND R. L. BARTGIS. 1987. The running buffalo clover. *In:* Roger L. DiSilvestro, Ed., Audubon Wildlife Report 1987. Academic Press, Orlando, FL.

NICKELL, A. K. 1981. Soil Survey of Dearborn and Ohio Counties, Indiana. U.S.D.A. Soil Conservation Service, Washington, DC.

THOMAS, D. 1916. Travels through the western country in the summer of 1816. *In:* Harlow Lindley, Ed., Indiana as Seen by Early Travelers. Indiana Historical Commission, Indianapolis.

M. A. H.
DIVISION OF NATURE PRESERVES
INDIANA DEPARTMENT OF NATURAL RESOURCES
ROOM 605 B, STATE OFFICE BUILDING
INDIANAPOLIS, IN 46204

J. R. A.
KENTUCKY CHAPTER OF THE NATURE CONSERVANCY
324 WEST MAIN STREET
FRANKFORT, KY 40601

E. M. J.
HOLCOMB RESEARCH INSTITUTE
BUTLER UNIVERSITY
4600 SUNSET AVENUE
INDIANAPOLIS, IN 46208